

WOODWARDOSTRONGYLUS PETROGALE SP. NOV. (NEMATODA: CLOACINIDAE), FROM THE STOMACHS OF ROCK WALLABIES (*PETROGALE* SPP.) FROM ARNHEM LAND

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Summary

BEVERIDGE, I. (1998) *Woodwardostromgylus petrogale* sp. nov. (Nematoda: Cloacinae), from the stomachs of rock wallabies (*Petrogale* spp.) from Arnhem Land. *Trans. R. Soc. S. Aust.* 122 (2), 73-78. 29 May, 1998.

Woodwardostromgylus petrogale sp. nov. is described from the stomachs of two species of rock wallaby (Marsupialia: Macropodidae), *Petrogale concinna* Gould, 1842 (type host) and *Petrogale brachyotis* (Gould, 1841) from Arnhem Land, Northern Territory. The new species is distinguished from congeners, *W. woodwardi* (Wood, 1931) and *W. obendorfi* Mawson, 1976 by the presence of four pairs of oral denticles compared with six pairs in *W. obendorfi* and 16 pairs in *W. woodwardi*, by the spicule length which is 0.90-1.07 mm in *W. petrogale* sp. nov. compared with 1.4 mm in *W. woodwardi* and 1.7-2.1 mm in *W. obendorfi*, by the length of the female tail which is 0.22-0.23 mm in *W. woodwardi*, 0.18-0.22 mm in *W. obendorfi* and 0.11-0.17 mm in *W. petrogale* sp. nov. In addition, the vagina is 0.7-1.0 mm in *W. woodwardi*, 0.8 mm in *W. obendorfi* but only 0.31-0.48 mm in *W. petrogale* sp. nov. The characteristics of the genus are considered as well as its relationships within the Cloacinae.

KEY WORDS: Nematoda, marsupials, rock-wallabies, *Petrogale*, *Woodwardostromgylus*, new species.

Introduction

One of the most unusual genera of nematodes occurring in the stomachs of kangaroos and wallabies is the cloacinid genus *Woodwardostromgylus* Wahid, 1964 which is found in tunnels in the superficial squamous epithelium of the stomach and oesophagus rather than in the lumen of the stomach or large intestine or coiled around oesophageal papillae as is the case with most of the other members of the family (Wood 1931; Mawson 1971, 1976; Beveridge & Spratt 1996). Two species are currently known within this genus, the type species, *W. woodwardi* (Wood, 1931) originally described from Woodward's wallaroo, *Macropus robustus woodwardi* Thomas, 1901, from the north of Western Australia (Wood 1931; Wahid 1964), subsequently redescribed from Pearson Island rock wallabies, *Petrogale lateralis pearsoni* (Thomas, 1922), from South Australia (Mawson 1971) and *W. obendorfi* Mawson, 1976 from the whiptailed wallaby, *Macropus parryi* Bennett, 1835 (type host), the wallaroo, *M. robustus robustus*, Gould, 1841 and the red-necked wallaby, *M. rufogriseus* (Desmarest, 1817), from north-eastern New South Wales and south-eastern Queensland (Mawson 1976). The latter species was subsequently reported as a common parasite of brush-tailed rock wallabies, members of the *Petrogale penicillata* complex (*P. assimilis* Ramsay, 1877, *P. godmani* Thomas, 1923, *P. herberti* Thomas, 1926, *P. inornata* Gould, 1842, *P. marécha* Eldridge & Close, 1992, *P. penicillata* (Gray, 1825) and *P. sharnani* Eldridge & Close, 1992) from eastern Queensland by Beveridge *et al.*

(1989) and has since been found also in the agile wallaby, *Macropus agilis* (Gould, 1842), and the swamp wallaby, *Wallabia bicolor* (Desmarest, 1804) (see Spratt *et al.* 1991). Spratt *et al.* (1991) listed an additional undescribed species of *Woodwardostromgylus* from the nabarlek, *Petrogale concinna* Gould, 1842 and the short-eared rock wallaby, *P. brachyotis* (Gould, 1841), from the Northern Territory. In the present paper, the undescribed species listed by Spratt *et al.* (1991) is described, the diagnostic features of the genus are reassessed and its position within the existing classification is discussed since the genus has in the past been variously allocated to the Strongyloidea (Wahid 1964) and the Trichostrongyloidea (Mawson 1971),

Materials and Methods

Nematodes were recovered from the preserved carcasses of rock wallabies provided by Dr J. E. Nelson, Monash University Melbourne Vic. Immediately after shooting, carcasses were perfused with 10% formal saline via the left ventricle followed by immersion of the entire carcass in 10% formalin. Nematodes recovered from the gastric mucosa were stored in 70% ethanol and were cleared in lactophenol for examination. Drawings were made with the aid of a drawing tube attached to an Olympus BH microscope. Measurements are presented in mm as the range for 5 specimens followed by the mean in parentheses. To examine the localisation of nematodes within the gastric mucosa, small pieces of parasitised stomach wall were embedded in wax and sections, cut at a thickness of 5 µm, were stained with haematoxylin and eosin. All nematode specimens have been deposited in the South Australian Museum, Adelaide (SAMA).

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Woodwardstrongylus petrogale sp. nov.
(FIGS 1-13)

Holotype: ♂ from stomach of *Petrogale concinna*, Arnhem Land NT, LXI, 1977, coll. J. E. Nelson, SAMA AHC 30592.

Allotype: ♀, same data, SAMA AHC 30593.

Paratypes: 9 ♂♂, same data, SAMA AHC 13790.

Other material examined: from stomach of *Petrogale brachyotis*, Arnhem Land NT, coll. J. E. Nelson, LXI, 1977: 10 ♂♂, 20 ♀♀, SAMA AHC 11071.

Description

Slender-elongate nematodes, cuticle covered with numerous fine transverse annulations. Mouth opening tiny, dorsoventrally elongate, apparently rigid; lateral margins of mouth opening each with row of four retractile, dome-shaped denticles; additional pair of tiny denticles at dorsal and ventral extremities of each row. Two amphids and four submedian papillae lateral to rows of denticles; nerve tissue extending posteriorly and laterally from sensory papillae. Subcuticular region of anterior extremity heavily sclerotised. Buccal capsule thick walled, with faint transverse striations; anterior part of buccal capsule dorsoventrally elongate in apical views of head, becoming circular posteriorly; buccal capsule supported externally by 10 prominent bands of muscle running from external surface of buccal capsule to longitudinal somatic musculature, two bundles of muscles present dorsally and two ventrally, two thick lateral muscle bundles and four slender submedian bundles. Oesophagus long and slender; corpus cylindrical narrowing slightly to form short isthmus; isthmus merging into elongate bulb. Nerve ring surrounding junction of oesophageal corpus and isthmus; secretory-excretory pore in mid-region of oesophageal bulb; deirid at level of secretory-excretory pore.

Male

Total length 13.1-15.5 (14.0); maximum width 0.17-0.23 (0.20); buccal capsule 0.020-0.037 (0.032) in length, width in lateral views 0.017-0.020 (0.019), in dorso-ventral views 0.010-0.013 (0.012); oesophagus 0.79-0.86 (0.83); nerve ring to anterior end 0.40-0.48 (0.42); secretory-excretory pore to anterior end 0.48-0.57 (0.52); deirid to anterior end 0.60 (0.60).

Bursal lobes short, of approximately equal length; ventral lobes joined ventrally; dorsal lobe small, slightly shorter than lateral lobes, not clearly demarcated from lateral lobes. Ventral rays slender, apposed, reach margin of bursa, externo-lateral ray slightly stouter than other lateral rays, divergent from

them, slightly recurved near extremity, not reaching margin of bursa; medio-lateral and ventro-lateral rays slender, apposed, reaching margin of bursa; externo-lateral ray arises from lateral trunk, straight, does not reach margin of bursa. Dorsal ray bifurcates close to origin; branches long, slender, arcuate; secondary division into branchlets occurs near extremity of ray; external branchlets short, directed postero-laterally, do not reach margin of bursa; internal branchlets longer, directed posteriorly, almost reach margin of bursa. Genital cone prominent, anterior lobe large, conical, extends almost to limit of ventral lobes; posterior lip small with pair of prominent posteriorly directed appendages; gubernaculum absent; central cordate and lateral paired elongate thickenings of spicule sheaths present at their junctions; spicules elongate, alate, 0.90-1.07 (0.97) long; anterior extremities irregularly knobbed; distal tips blunt; ala diminishes in width towards spicule tip.

Female

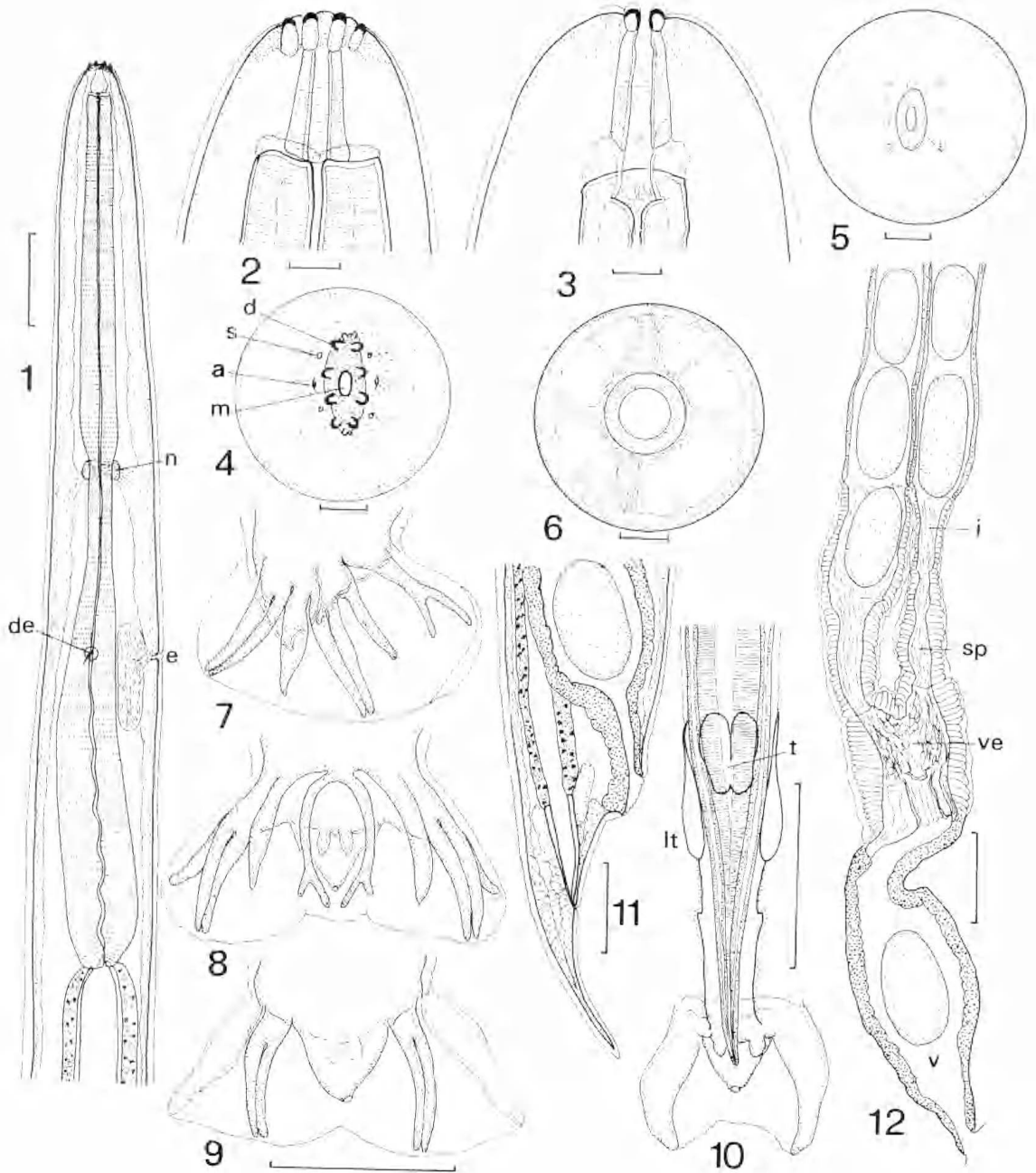
Length 16.4-22.8 (20.1); maximum width 0.18-0.29 (0.27); buccal capsule 0.027-0.034 (0.030) in length, width in lateral views 0.020, in dorso-ventral views 0.010-0.015 (0.013); oesophagus 0.92-1.28 (1.01); nerve ring to anterior end 0.24-0.44 (0.39); secretory-excretory pore to anterior end 0.57-0.65 (0.62); deirid to anterior end 0.58-0.65 (0.62). Tail short, conical 0.11-0.17 (0.15), vulva immediately anterior to anus, 0.23-0.32 (0.26) from posterior end. Vagina short, straight, directed anteriorly, 0.31-0.48 (0.39); vestibule in form of Y, with thick muscular walls, 0.15-0.20 (0.17) long; sphincter and infundibulum of approximately equal lengths, very variable in length, each 0.08-0.25 long; uteri parallel, run anteriorly from infundibula; egg ellipsoidal, 0.13-0.14 (0.13) x 0.07-0.09 (0.08).

Localisation within stomach

Nematodes lie in small sinuous tunnels in the superficial layer of the stratified squamous epithelium of the forestomach. Nematodes were not found penetrating as deeply as the *lumina propria* and the presence of the nematodes in the squamous epithelium provoked no inflammatory response. The anterior ends of the nematodes were buried in tunnels while the posterior ends lay free in the gastric lumen.

Discussion

The nematode species described above belongs to the Cloaciniinae Stossich, 1899 because it possesses a cylindrical buccal capsule, a bursa in which the dorsal lobe has four branches, the externo-dorsal ray arises from the lateral trunk and a cervical groove is



Figs 1-12. *Woodwardstrongylus petrogale* sp. nov. 1. Anterior end, lateral view. 2. Cephalic extremity, lateral view. 3. Cephalic extremity, dorsal view. 4. Cephalic extremity, apical view. 5. Transverse optical section through anterior end of buccal capsule. 6. Transverse optical section through posterior part of buccal capsule showing muscle bands running radially from outer wall of capsule. 7. Bursa, lateral view. 8. Bursa, dorsal view. 9. Bursa, ventral view. 10. Posterior end of male, dorsal view showing spicules and thickenings of spicule sheaths at their junction. 11. Female tail lateral view. 12. Female genital system, lateral view. Scale bars = 0.1 mm 1, 7-12; 0.01 mm 2-6. Legend : a, amphid; d, denticle; de, deirid; e, secretory-excretory pore; i, infundibulum; lt, lateral thickening of spicule sheath; m, mouth opening; n, nerve ring; s, submedian cephalic papilla; sp, sphincter; t, central thickening at junction of spicule sheaths; v, vagina; ve, vestibule.



Fig. 13. Histological section of the stomach wall of *Petrogale imitans* showing localisation of *Woodwardstrongylus petrogale* sp. nov. (n) in a superficial squamous epithelial tunnel (arrows) formed by the nematode and the lack of any inflammatory reaction in the epithelium. Scale bar = 0.1 mm.

lacking. It belongs to the genus *Woodwardstrongylus* because it possesses a heavily sclerotised mouth region, a transversely striated buccal capsule and a row of sclerotised denticles on either side of the mouth opening, the latter characteristic being the most obvious feature defining the genus. The specimens described above are distinguishable from *W. woodwardi* and *W. obendorfi* primarily by the number of pairs of sclerotised oral denticles. *Woodwardstrongylus woodwardi* possesses 16 pairs of denticles while *W. obendorfi* possesses six pairs. In all of the specimens from *Petrogale* spp. from Arnhem Land, there are four large pairs of denticles. At each end of the rows of denticles, there is a pair of tiny denticles which has not been included in the determination of the number of pairs of denticles because these denticles are not obvious in lateral views and are only clearly visible in an apical view of the mouth region. The same terminal pairs of tiny denticles are evident in the scanning electron micrograph of the cephalic extremity of *W. obendorfi* published by Mawson (1976, fig. 11) although the feature is not mentioned in the description and was not taken into consideration when determining the number of pairs of denticles on each side of the mouth opening. Whether these same terminal pairs of tiny denticles are present in *W. woodwardi* is not known. In addition, the specimens described above differ from congeners in spicule length, being 1.4 mm in *W. woodwardi* (Wood 1931), 1.7–2.1 mm in *W. obendorfi* (see Mawson 1976) compared with 0.90–1.07 mm in the species described above. There is also a corresponding difference in the length of the vagina which is 0.7–1.0 mm long in *W. woodwardi*, 0.8 mm in *W. obendorfi* and 0.31–0.48 mm in the species described here. Therefore, the material from

rock wallabies from the Northern Territory is considered to represent a distinct species and the name *Woodwardstrongylus petrogale* sp. nov. is proposed for it, the name being derived from the generic name of the hosts.

In comparing the description of the new species with those of its congeners, several morphological characteristics of the genus warrant comment due to apparent inconsistencies or errors in published descriptions.

The oesophagus is described in the other species as being slender and clavate yet in *W. petrogale* there is a distinct constriction at the level of the nerve ring and the oesophagus is clearly divisible into corpus, isthmus and an elongate bulb. Specimens of *W. obendorfi* were examined and the same subdivisions of the oesophagus are evident although they have not been illustrated or described in the literature. The structure of the oesophagus is of considerable taxonomic significance because it is clavate in genera of the tribe Cloaciniinae (Stossich, 1899) of the Cloaciniinae but is subdivided into corpus, isthmus and bulb in the tribe Pharyngostrongyliinae Popova, 1952 into which *Woodwardstrongylus* has been placed (Lichtenfels 1980). The revised interpretation of these morphological characters therefore becomes concordant with the current taxonomic position of the genus.

In the original description of the genus, Wahál (1964, fig. 11) described and illustrated a "gubernaculum" in the type species, *W. woodwardi*. In the original description of the same species, however, Wood (1931) had been much more cautious and had described "an accessory piece... present as an irregular shaped structure" which "appears to function as a guide for the spicules". Mawson (1976) stated that a gubernaculum was present in *W. obendorfi* but did not illustrate the structure. Durette-Desset & Beveridge (1980) illustrated the "gubernaculum" of *W. obendorfi* but it is clear from the illustration that the structure is not a gubernaculum but the cordate thickening at the junction of the spicule sheaths (Beveridge 1982). A gubernaculum is absent in *W. petrogale*, although it does possess a cordate thickening and paired lateral thickenings of the spicule sheaths at their junction in common with all other cloaciniids and chabertiids that have been examined for the presence of the structures (Beveridge 1987). It therefore seems most likely that a gubernaculum is absent in this genus and the cordate central thickening at the junction of the spicule sheaths has been mistaken for a gubernaculum in the past. This problem pertains to several genera of the Pharyngostrongyliinae and has been discussed in detail by Beveridge (1982).

The morphology of the female genital system has not been described in detail for *W. woodwardi*,

although Mawson (1971) illustrated an essentially Y-shaped oesophageal sucker with parallel, amphidelphic uleri in her redescription of this species from rock wallabies from South Australia. The oesophageal sucker was described for *W. obendorfi* by Durette-Desset & Beveridge (1980) who illustrated a short Y-shaped vestibule with short sphincters and infundibula and suggested that the morphology of the oesophageal sucker was intermediate between that found in the Trichostrongyloidea and the Strongyloidea. Lichtenfels (1980) classified the oesophageal sucker of *Woodwardostrongylus* as typically strongyloid and as being Y-shaped superficially, but resembling related genera with J-shaped oesophageal suckers in that the sphincters and infundibula are short. The oesophageal suckers of *W. petrogale* are similar to those of *W. obendorfi* and confirm Lichtenfels' interpretation. Beveridge (1987) illustrated the oesophageal sucker of *W. petrogale* (described simply as *Woodwardostrongylus* sp.) and confirmed that it too agreed with the description and allocation suggested by Lichtenfels (1980). The oesophageal sucker in this genus is therefore considered to be a modified J-shaped oesophageal sucker according to the definitions of Lichtenfels (1980), with the modification probably being a direct result of the slender elongate body structure imposed upon this nematode genus by its localisation within epithelial tunnels of the gastric mucosa.

The systematic position of the genus *Woodwardostrongylus* has been the subject of some uncertainty. The type species was initially described as *Pharyngostrongylus woodwardi*, indicating a close relationship with the genus *Pharyngostrongylus* Yorke & Maplestone, 1926. Wahid (1964) subdivided the genus *Pharyngostrongylus* and erected the new genus *Woodwardostrongylus* for *W. woodwardi* but provided no explanation of its possible relationships with *Pharyngostrongylus*. Mawson (1971) redescribed *P. woodwardi* from rock wallabies and erected the new genus *Cristiceps* which she placed in the trichostrongyloid family Amidostomatidae (Travassos, 1919) based on the papers of Inglis (1965, 1968) dealing with convergence of the cephalic features of nematodes occurring buried in the stomach lining of their hosts and his view that many of the strongyloid nematodes of Australian marsupials were members of the trichostrongyloid family Amidostomatidae. Subsequently, in describing *W. obendorfi*, Mawson (1976) recognised the synonymy of *Cristiceps* with *Woodwardostrongylus* but placed *Woodwardostrongylus* within the Amidostomatidae. Durette-Desset & Beveridge (1980) in contrast referred the genus to the Strongyloidea and Lichtenfels (1980)

placed the genus in the strongyloid tribe Pharyngostrongylinea characterising the tribe primarily on the basis of a buccal capsule with transverse striations and thereby re-associating *Woodwardostrongylus* with *Pharyngostrongylus*, the genus with which it was first linked by Wood (1931). Beveridge (1982), in a revision of the Pharyngostrongyloidea, omitted *Woodwardostrongylus* on the basis of uncertainties as to its affinities. The addition of a new species confirms the characters upon which the genus was erected while providing some modification to the definition of the genus, principally in relationship to the morphology of the oesophagus and oesophageal sucker and the absence of a true gubernaculum. The association with members of the Pharyngostrongyloidea is supported on the basis of a transversely striated buccal capsule, although this character occurs also in certain genera of the related tribe Zoniolaimiinae (Popova, 1952) (Beveridge 1983). This morphological character appears to be the only feature upon which affinities can be judged because other characteristics of the genus are so highly modified to accommodate its unusual mode of existence within the stomach wall that they are phylogenetically uninformative. Therefore, in view of the lack of evidence to the contrary, and with the limited or even equivocal evidence of associations based on the presence of a striated buccal capsule, it seems reasonable to consider *Woodwardostrongylus* as a highly modified member of the tribe Pharyngostrongylinea.

The host and geographical distributions of members of the genus are not yet fully elucidated. On the basis of current evidence, *W. obendorfi* occurs in a variety of rock wallabies, scrub wallabies and kangaroos along the eastern coast of Queensland and New South Wales. *W. woodwardi* is known from kangaroos originating from the northwest of Western Australia (although based on a zoo record from Britain) and from rock wallabies in South Australia, while *W. petrogale* is known from rock wallabies from Arnhem Land in the Northern Territory. The feature common to all members of the genus is that they parasitise rock wallabies but host relationships warrant more thorough investigation before any conclusions can be drawn from this observation.

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